near the Oxford University Parks, and on the following day I captured eleven more in the same place. There had been exceptionally heavy rain, extending over some days, immediately previous to those on which I found the specimens, and it therefore seems probable that these animals are driven out of the earth when it becomes sodden with moisture. Thus it is possible to account for the capture of a very unusual number of specimens, for, as far as I can learn, the species has hitherto only been met with singly in this locality.

I have also ascertained what happens to the animals when the earth in which they are contained becomes hard and dry from the loss of water. A few of the twenty-two specimens were killed and hardened, and the remainder were put in a box containing earth, in which they buried themselves. In the press of other work the box was neglected, and remained untouched in my laboratory until to-day, the earth having quickly dried into a hard cake. To-day I emptied the box, and fully expected to find the slugs dried up dead, but to my surprise I found twelve specimens alive, each encysted in a thin transparent capsule formed of the hardened mucous secretion of the animal's skin. The body was contracted, and oval in shape, but it had been so completely protected from evaporation that there was no noticeable reduction in bulk after these hottest months of the year, during which water had been entirely withheld. One or two specimens had died almost immediately after capture, and a few escaped, so that all those which had been exposed to the heat and dryness in the box had become encysted, and survived in apparent health.

EDWARD B. POULTON

Wykeham House, Oxford, October 19

Lepidoptera and Migration

THE subject of migration in connection with Lepidoptera is beginning to receive some attention at the hands of our best lepidopterologists. I am decidedly of opinion that the abundance or scarcity of many species of Lepidoptera is largely regulated by migrations from abroad. Last year our southern shores were visited by an abnormal number of rare *Sphingidæ*, but this year there have scarcely been any records of captures published concerning them. It would be interesting to know what are all the influences which cause these migrations, and if there is a periodicity to the phenomenal occurrences.

Birmingham, October 12

W. HARCOURT BATH

The Earthquake of October 16 in the Vosges, &c.

MAY I be allowed to call attention to the fact that Alsace lies on the direction of the great circle, "boundary of Tertiary formation of the United States," mentioned in my letter which appeared in your number of the 14th inst. (p. 570), and furthermore that Strasburg has been repeatedly shaken since 1355, the first date which I found recorded as having been marked by a shock. It is quite true that the interval between that shock and the next recorded (1556) was 201 years; but the greatest subsequent interval, that between the shocks of 1577 and 1655, was only of 78 years. This interval represents a multiple of 13, being = 13 × 6. The interval of 13 is of frequent recurrence, as I purpose to show in a paper which I have about terminated on this question of intervals and periods of earthquakes.

J. P. O'REILLY

Royal College of Science for Ireland, Stephen's Green,
Dublin, October 23

RECENT ORNITHOLOGICAL WORKS

THE future student of British birds ought to have little difficulty in working out the distribution of species within the shores of Great Britain, so much excellent work having been done in the way of local lists during the last few years, and certainly one of the most useful will be the little work on "The Birds of Cumberland and Westmoreland," just issued by the Rev. H. A. Macpherson and Mr. W. Duckworth.[1] The situation of these two counties is interesting, especially to the student of migration, and the notes on the passage of water-birds and sea-birds are particularly good. The completeness of the information, and the concise and simple form in which it is conveyed, render this small book a model of what a faunistic work should be, and it forms a worthy accompaniment to the many excellent county lists of birds which have appeared in England during the last twenty years. It would be well if every expiring species in Great Britain had had its death-song as well sung as is the case with the Dotterell, by Mr. F. Nicholson, in the present work. While Protection Acts are spreading their ægis over many birds in the breeding season, so that the numbers are visibly increasing, and the enlightened care of a few landed proprietors aids the work of bird-preservation, there are still a certain number of species whose nesting days in this country are numbered, and which, like the Great Bustard and the Bittern, are doomed by the inexorable advance of civilisation to seek less over-crowded countries in which to breed. The (too probably final) breeding of the Dotterell in Cumberland is therefore appropriately described by Mr. Nicholson, who has himself taken the eggs in the county. An excellent account is likewise given of the breeding of the Pied Flycatchers.

We learn with some surprise that the White-headed Long-tailed Titmouse of Scandinavia, the true *Acredula caudata* (Linn.), "may be detected in Cumberland in mid-winter," when "the appearance of a flock of adults in their snow-white caps is refreshing to an insular observer." We should like to see some of these Titmice, and may state that an example is a desideratum to the national collection, where we should be glad to receive a specimen. Our experience in France, where we have shot *all three* races of the *Acredula caudata*, is that it is impossible to detect the difference of the forms when in the open, though a difference in note led to our recognising *A. irbii*. We can only consider the true *A. caudata* to be a very occasional, though not impossible, migrant to our shores, and we by no means sympathise with the authors of the "Birds of Cumberland" in their suppression of the name of *Acredula rosca* for the British Long-tailed Titmouse, from a dislike to the "needless multiplication of species." As regards Great Britain the facts are perfectly plain. The resident *Acredula* is always recognisable, and the white-headed form is only a very occasional winter visitant, and however much they may interbreed in the Rhine Provinces or elsewhere on the Continent, there is nothing of the kind in England, where perfect differentiation exists; and therefore to say that our English Long-tailed Titmouse should be called *Acredula caudata* of Linnæus, is a mistake and nothing else, for that name belongs to the Swedish form. Those ornithologists who continue to do this suppress a most interesting fact in nature, viz. that the isolation of the British Islands from the rest of Europe has produced a well-marked modification in the colour of some of our birds, amounting in certain instances to a subspecific value. The same reasoning applies to the Coal Titmouse, where our authors state that "British specimens have *generally* olive backs, as contrasted with the slate-gray backs of typical German specimens, but intermediate forms occur." This is not our experience. In summer plumage, when the olive-brown tips and the feathers become shed, the back of the English Coal Titmouse is gray, and then it is difficult to tell it from a summer-plumaged *P. ater* from the Continent. But if two winter-killed birds are compared, the difference between the British and Continental specimens is very strongly marked, for the back in the latter remains gray, whereas in the British form it is olive-brown. Having been the first, as we believe, to detect this modification in the British form, we have, ever since we first gave it the name of *Parus britannicus*, assiduously collected a series of specimens in the British Museum, and we have never seen reason to modify our original opinion, nor have we yet seen the intermediate forms for which our authors vouch.

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[1] "The Birds of Cumberland critically studied, including some Notes on the Birds of Westmoreland." By the Rev. H. A. Macpherson, M.A., and William Duckworth. (Carlisle, 1886.)

We must not conclude our notice of this interesting volume without calling attention to the excellent plate (by Keulemans) of the Dotterell in summer plumage, and of the useful coloured map, an indispensable adjunct for the proper comprehension of a well-written local avifauna such as the present.

We have recently received from America two publications of the highest value, dealing with the expeditions prosecuted under the auspices of the United States Government in the high north. In the *Bulletin* of the United States National Museum, Dr. Leonard Stejneger gives his "Results of Ornithological Explorations in the Commander Islands and Kamchatka." Dr. Stejneger has worked hard for several years at Palæarctic and Nearctic ornithology, and of the many important contributions from his pen the present *Bulletin* is perhaps the most noteworthy. Although Kamchatka has been visited by several of the Russian naturalists, the published information respecting its ornithology has been meagre enough, if we except the labours of Dr. Dybowski, whose collections have been described by himself and Dr. Taczanowski. Dr. Stejneger divides his work into three parts: (1) a review of the species of birds collected or observed by himself on the Commander Islands and at Petropaulowski in Kamchatka; (2) a synopsis of the birds reported to inhabit Kamchatka; and (3) conclusions. One hundred and forty species were obtained by Dr. Stejneger himself, and of all of these he gives a full account, with synonymy and measurements. Naturally, the Auks, which abound in the Japanese and Kamchatkan seas, come in for a large share of attention, and Dr. Stejneger's description of these difficult species is very complete, especially as regards the shedding of the lamellæ of the bill, on which Dr. Bureau and Dr. Dybowski have had much to say in their writings. As these observations are accompanied by illustrations coloured on the spot by the author from freshly-killed birds, there can be no doubt that they will be of inestimable value to the future student. Several new species are described, most of them, as might be expected, being extreme forms of Siberian birds. *Cuculus peninsulæ* represents *C. kelungensis* of Japan, *Dryobates purus* and *D. immaculatus* take the place of the Palæarctic Woodpeckers, *D. major* and *D. minor; Pica Kamchatica* that of the Magpie, *P. caudata.* The synonymy of the Redpolls is well treated, and a series of exhaustive measurements given. We can scarcely believe in the new race of the Scarlet Grosbeak, *Carpodacus erythrinus grebnitzkii*, seeing the variation which takes place in a series of *C. erythrinus* from other localities; nor can we distinguish the Kamchatkan race of the Yellow Wagtail, *Budytes flava leucostriatus*, which seems to us to be inseparable from *B. flava* of Europe, of which species it is an Eastern colony. If the differences pointed out by Dr. Stejneger hold good, it will solve an interesting problem in geographical distribution, because it will be much more simple to recognise three forms of *B. flava:* the ordinary one breeding in Europe and wintering in Africa; an Eastern form, *B. leucostriatus*, breeding in Eastern Siberia and wintering in the Malay Archipelago; and a central one, *B. beema*, breeding in Siberia and wintering in India. At present we have fully recognised the latter, whereas the European and East Siberian birds appear to be identical, though possessing well-defined breeding and wintering habitats, with the Central Siberian bird interposed as regards its breeding and winter range. Our synonymy of the Pied Wagtails in the "Catalogue of Birds" does not appear to be quite the same as Dr. Stejneger's, but the ground has now been cleared for Mr. Nicholson or the next bold man who makes the *Motacillidæ* a special study. The problems concerning the Wrens of the East which our author presents us with require careful consideration, and show that these representative forms cannot be disposed of in the off-hand way recently attempted by Mr. Dresser. Let no ornithologist neglect to study the "Conclusions" with which Dr. Stejneger finishes his work, as there are some admirable critical notes; and in conclusion we congratulate America on having gained from Europe such a thorough worker as the author of this volume shows himself to be. We have perused every page of his "Review" with interest, only regretting that our series of Kamchatkan birds is so poor in the British Museum that we have not been able to study, as we should have liked to do, with the specimens in our hands.

The bulky volume entitled a "Report of the International Polar Expedition to Point Barrow, Alaska" contains 24 pages of ornithology, by Dr. Murdoch, and many excellent notes on the birds are given. The chief interest centres round Ross's Gull, of which the Expedition "succeeded in obtaining a large series—more, in fact, than there were before in all the museums of the world put together." Coloured figures of the adult and young are given. So, slowly but surely, are the great desiderata of bird collections being rendered available for science. Only a few months ago this Gull was reckoned one of the greatest prizes to be obtained, and now we not only know the immature plumages, but something of its migrations and habits. Its previous rarity may be imagined from the fact that until the present year no specimen existed in the British Museum, where now, thanks to the liberality of Mr. Henry Seebohm, a fine adult bird is exhibited.

Our colleague, Mr. A. G. Butler, has varied his entomological pursuits by publishing a little work on British Birds' eggs,[1] the figures of which he has drawn himself; and he has shown himself as capable a draughtsman of eggs as he is admitted to be of Lepidoptera. The plates bear evidence of the difficulty which the author has experienced in mastering the shadows of the objects, as several plates are differently treated in this respect; and perhaps it would have been better if Mr. Butler had redrawn some of the earlier plates which did not satisfy him. The chromolithography, for which Messrs. Mintern are responsible, is certainly on the whole satisfactory, and may be found available for this kind of illustration, though we notice a tendency to heighten the colour, which in our opinion has hitherto proved an obstacle for the employment of the process as regards birds themselves. The figures of the eggs are, however, undoubtedly good, and no book yet published in this country shows in a better degree the variation in form and colour which eggs are subject to. In this respect Mr. Butler's little work will be useful to all oologists, and it can confidently be recommended to the young beginner as a hand-book. The letterpress is too short for a complete account of the nidifications of the birds, but contains a good deal of information in a narrow compass.

An "Oxford Tutor" in his little work, "A Year with the Birds," discourses pleasantly enough about his feathered favourites; and whether in the classic grounds of a college garden or in the mountains of Switzerland shows himself an observant student of Nature. We have read this book with considerable pleasure, and it has carried us back in memory to many such scenes as the author describes, though we have lacked his easy facility of recording his experiences. As he is interested in migration, we recommend his spending an autumn holiday on the milder parts of the south coast, where he may really meet with a "flock" of Blackbirds, and even of Robins and Hedge-sparrows. So keen an observer will find scope for his energy in the unravelling of some of the difficult problems which yet surround the study of some of our British species, and we may venture to point out to him one or two facts which have occurred to us during the perusal of his book. Thus, when he speaks of the Wheatear in Switzerland (p. 61) as "an English species," we want to know whether it is the large or the small form which he met with. Again, on p. 73, when he talks of the "sheet of water or marshy ground which might attract the waders and sea-birds so commonly found near Oxford," is it not the east wind which drives the latter along the course of the Thames, rather than any peculiar attraction of the country near Oxford? The fact of the Cuckoo carrying her egg in her bill for deposit in the nest of her victims is now universally admitted; but what concerns ornithologists is the greater or less resemblance of the egg deposited by the female Cuckoo to the eggs of the foster-parents which she selects to bring up her young. The Spotted Flycatcher has undoubtedly a song (p. 83), but it is a poor affair, and is heard only, according to our experience, at daybreak. It is true that the Green Sandpiper (p. 86) has really only the legs greenish, but the reason of the perpetuity of the name to which our author objects, is because Linnæus called the species *ochropus*, and the name adopted by the older English writers was the *Green* Sandpiper, which has been handed down to the present generation, as is also the case with the Grey Wagtail. The author knows his "Dresser" and his "Harting," but he can learn something of the affinity of Robins and Redstarts (pp. 88, 101) from Mr. Seebohm in the British Museum "Catalogue" (vol. v.), or in his "History of British Birds." The little essay on the "Birds of Virgil" is most interesting, especially with regard to the *Alcyon*, which, we agree with the author and his authorities, was probably *not* our Kingfisher, though the presence of the latter on the sea-shore in some numbers is a fact at the season of the autumn migration. We offer these few remarks to the author as points of further study on which we should be glad to have the observations of a true naturalist, such as he evidently is.

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[1] "British Birds' Eggs: A Hand-book of British Oology." By A. G. Butler, F.L.S. 8vo. (London, 1886.)

The Rev. Gregory Smart has recently published a little book on the "Birds on the British List," which is a *critique* on the list issued by the British Ornithologists' Union, which he collates with the works of Mr. Dresser, Mr. Seebohm, and the fourth edition of "Yarrell." The book is disfigured by a slovenly style of writing, for which the printers' errors can scarcely account, and this is the greater pity, as the author's intentions are good, and he scores distinctly on several occasions when dissecting the evidence on which some birds are admitted to the British List while others are rejected; but the English in which he endeavours to record his conclusions is, to say the least of it, a little mixed. The author confesses to "having had but little experience," and it would therefore have been better to have restricted himself to the main object of his book, viz. the criticism of the evidence on which some species are retained or rejected in the works above alluded to. When he gets outside the boundary of his *critique*, he talks in some instances simple nonsense, as in his remarks on the Gold-vented Bulbul (p. 18). Mr. Dresser and Mr. Bidwell, in aiding and abetting Mr. Smart in his hap-hazard identification of his Bulbul's egg, could scarcely have expected the punishment of having their rash opinion published to the world. On p. 41 some more nonsense appears about *Anthus ludoricianus* and *A. campestris* being conspecific! The author would seem to be unaware that "Ungaru" is generally spoken of as "Hungary" by English writers, and that "Los Angelos Cala" is a locality which will puzzle many an "inexperienced" collector for whose benefit Mr. Smart professes to write. We would advise the author, before publishing another book, to get some friend to look over his manuscript for him, as a good deal of the difficulty of unravelling the meaning of his sentences would have been avoided by a simple attention to stops and commas, which is not too much to expect from a "late Scholar of Trinity College, Cambridge."

R. BOWDLER SHARPE

SOLAR PHYSICS[1]

MOST of our readers are aware that the sun, as constructed by Zöllner, was a white-hot, liquid body, that its spots were scoriaceous products of local cooling, and that its atmospheric circulation was closely modelled upon the terrestrial, with trades and anti-trades, an equatorial belt of calms, land- and sea-breezes, the last due to the contrast of temperature between the slag-islands constituting spot-nuclei, and the incandescent ocean in which they floated. On these lines M. Schulz has reared a solar edifice out of materials to a large extent new. Sixteen additional years of results in one of the most rapidly progressive branches of modern physical astronomy, give him an advantage over his predecessor, utilised to the utmost in modifying, extending, and generalising views of which he is the intrepid, though not blind, partisan. The upshot, we venture to assert, is to prove them wholly untenable. If M. Schulz's ingenious advocacy fail to recommend them, their inherent weakness must be great. Our readers shall judge for themselves of its success.

In the work before us it is undertaken to account for the whole array of solar phenomena, from the conservation, through long geological ages, of the solar activity, and its cyclical fluctuations, to the production of a pore or a facula. With this alluring prospect in view we are invited to regard the sun as a liquid globe composed of unknown substances, glowing at a temperature somewhere between 10,000° and 20,000° C. Although the heat rises towards the centre by a very low gradient, the inequality suffices to insure the distribution of the loss by radiation throughout the bulk of the globe, vertical convection-currents carrying down the cooler and heavier outer layers, and replacing them with hotter and more buoyant materials from the interior. Thus the danger is averted of the light-and-heat-giving career of our luminary being brought to a premature close by the untimely formation of a crust. The relative permanence of that career is further secured by the application to a liquid sun of Helmholtz's gravitational principle of the maintenance of solar heat.

The extensive atmosphere surrounding this molten mass is composed mainly of the unknown gas emitting Kirchhoff's "1474" line. This, in M. Schulz's opinion, is the primitive and simplest form of matter. Its atoms, many times lighter than those of hydrogen, are the fundamental units by the various aggregation of which the atoms of all other substances whatsoever are constructed. It plays, as we shall presently see, a very important part in the solar economy devised by our author. The solar supply of it is on a prodigious scale, since it fills, mixed with small percentages of hydrogen, helium, and metallic vapours, the vast spherical shell visible during total eclipses in the form of a "corona."

In the lowest strata of this gaseous envelope the photosphere hangs suspended at a height of a few thousand miles above the real surface of the sun. Its structure resembles that of our cirrus-clouds, only that metallic and incandescent condensing particles are substituted for aqueous frozen ones. The Fraunhofer absorption M. Schulz brings about by the customary machinery of the "reversing layer," regardless of the growing objections on the part of leading solar physicists to its exclusive employment in that capacity. Indeed the details of spectroscopic evidence scarcely receive from him the minute attention they deserve. Mr. Lockyer's researches on "lines widened in spots" give an example of the kind of work that has henceforth to be done on the solar spectrum. Summary explanations of its phenomena no longer suffice. Each one of its thousands of dusky rays has an individual story to tell, well worth the trouble of

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[1] "Zur Sonnen-Physik." Von J. F. Hermann Schulz. Separatabdruck aus der *Gaea*, Bände xxi. und xxii., 1885-86. (Leipzig: W. Drugulin, 1886.)